



UGVCL

UTTAR GUJARAT VIJ COMPANY LIMITED



CIN – U40102GJ2003SGC042906,GST No.-24AAACU6551F1Z1
TENDER NOTICE No:-UGVCL/PROJECT/BOL/WOMEN'S PARK/76

**TECHNICAL SPECIFICATIONS FOR
MAINTENANCE FREE, ECO-FRIENDLY, READY CAPSULE, PIPE-IN-CAGE (PIC) TYPE EARTHING**

1.0 SCOPE:

This specification covers supply, installation and testing of maintenance free, Ready Capsule, Pipe-in-cage, special type earthing system for distribution network. The technical specification is designed keeping in view following advantages,

- In this type of Earthing Electrode, the electrode, the surrounding enhancing material bonding with electrode and the cage are in pre-fabricated, ready to use form so that on-field mal-practice in form of less digging of earth pit, less Earth enhancement filling, improper watering at site, can be overcome. This makes the quality check very convenient.
- Due to pre-fabricated, ready to use methodology, no on-field wastage of Earth enhancement material is done.
- Installation procedure is effective, convenient, less time consuming and cheaper.
- Transportation and storing of material, compare to separate component (i.e. electrode, Earth Enhancement compound, etc.) on field is convenient, cheaper and too easy to do.
- Quality assurance of this type of earthing can be carried out very effectively with minimum effort.

2.0 APPLICABLE STANDARDS:

This earthing system shall be conformed to the relevant standard specification unless otherwise specified, in line with the requirement of any of the latest applicable standard. The applicable amendments as and when imposed shall be applicable.

1.	IS: 3043/1987	Code of practice for Earthing
2.	IEC 62561-7	Requirement of Earthing Enhancement Compound
3.	IEEE-80- 2000	IEEE Guide for Safety in AC Sub Station Grounding
4.	ASTM G57-06	Test Method for Field Measurement of Soil Resistivity, Using the Wenner, Four-Electrode Method
5.	IS : 2629 & IS: 4736	For hot dip galvanizing for Iron and Steel
6.	IS:1161/1979	Steel Tubes for Structural Purposes: Specification
7.	IS:13229-1991	Zinc for Galvanizing

GENERAL REQUIREMENTS:

5. Earthing Technical Spec.docx



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- a) This maintenance free earthing system shall be based on ready capsule type, Pipe-in-Cage technology concept in which, One Galvanized hollow pipe (Electrode) is kept inside the Galvanized Perforated cage as per drawing. The space between the electrode and cage shall be filled with a specially developed earth enhancement material(EEM) made up of Conductive Cement, Graphite carbon powder, Sodium montmorillonite/ Sodium Bentonite Powder, Hydrous aluminum silicate etc. to reduce earth resistivity.
- b) The system shall be almost maintenance free and require no periodic or scheduled maintenance for an expected period of 15 years.
- c) There shall be no requirement to add any other chemical or water at any time after initial installation because of hygroscopic characteristic of Earth Enhancement Material (EEM).
- d) The material offered shall conform to relevant standard with high quality and good workmanship capable to perform continuous and satisfactory operations in the actual service conditions atsite.

3.0 EARTH ELECTRODE:

The earth electrode is the main component of the earthing system which is meant for collecting, releasing, and discharging earth leakage and fault currents. The earth electrode should be ready capsule type made with Pipe-in-Cage (PiC) technology concept. It includes the hollow MS pipe, as a primary electrode which should have IS marking as per IS: 1161-1979. For effective life of the earthing system, the whole shall be provided a zinc coating up to 150 microns through hot dip process. The zinc used for galvanizing should follow Zn 98.0 Grade as per IS: 13229-1991 and process and measurement of hot dip galvanizing should be as per IS: 2629.

The outer cage of GI pipe shall be provided with maximum 3.5 mm dia holes and shall be hot dip galvanized with minimum 80 microns.

- Dimensions: -Here, two different size electrodes are proposed, i.e. 2000 mm and 3000 mm length electrode. Generally, electrode having 3000 mm length is preferable, but where digging of 3000 mm pit is not possible, two parallel earthings of electrodes having 2000 mm length are to be used.
- Primary Electrode: Dimensions of the electrode are as under, however, detail dimensions are shown in the attached drawing No. GPRD-16 & GPRD-17. All the tolerances and other specifications to the same should be as per IS: 1161-2014.
 - I. Length (L):
 - a. 1900 mm (pipe) +100mm (terminal) =2000 mm (Min.)
 - b. 2900 mm (pipe) +100mm (terminal) =3000 mm (Min.)
 - II. Outer Diameter (Ø): 48 mm (hollow) (Minimum)
 - III. Thickness (t): 3.2 mm (Min.)
 - IV. Weight of electrode: To be followed according to limit specified in IS
- Perforated Cage :
 - a) 1890 mm X 150 mm for 2000 mm Electrode (Minimum)
 - b) 2890 mm X 150 mm for 3000 mm Electrode (Minimum)
 - c) Circular Hole Size for cage: 3.5 mm Dia. Or lesser
 - d) Thickness of Net: 1.5 mm (min.) with hot dip galvanized

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- Terminal: Each Earth pipe must be provided with a connection terminal facility as shown in drawing by pressing of 100 mm at the top side of the pipe to form a strip having dimensions as mentioned in drawing without joint or welding. The pipe shall be pressed by hydraulic press only. No hammered pressed/ welding shall be acceptable. Two numbers of hole of diameter as mentioned in the drawing shall be provided in the pressed portion of the top side of pipe.
- Electrically Insulated Enameled Paint Coating: As shown in the drawing No. GPRD-16 & GPRD-17, the electrically insulated enameled paint coating has to be applied on the 150 mm length of electrode immediate after the compressed portion of the electrode (terminals). Also, optionally PVC cap of appropriate die-electric strength can be provided to prevent the flow of current in the upper portion. The enameled paint coating should have minimum Dielectric strength-20 Kv/mm and min. 4 coat should be applied to the surface of electrode. This is done in order to prevent the danger to the living being from Step potential.
- Zinc coating: The earth electrode consists of one mild steel pipe with provision of connections at top end as shown in the attached drawings No. GPRD-16 & GPRD-17. The entire electrode shall be hot dip galvanized with at least 150 microns over all surfaces without leaving any point of the electrode un-galvanized and cage shall be hot dip galvanized with at least 80 microns in accordance with IS 4736: 1986 in accordance with IS 4736: 1986. The process of hot-dip galvanizing shall be followed as per IS: 2629. For uniform distribution of fault currents, an earth electrode must be cylindrical in shape.
- Short Time Current Rating: The earth electrode shall be capable to withstand minimum 20 KA (rms) short time current for 1 sec.

4.0 EARTH CONDUCTIVITY ENHANCEMENT MATERIAL:

- a) It shall be placed between primary earth electrode and perforated cage to improve the conductivity of earth electrode & ground contact area. Earth enhancement material (Back fill compound) shall be according to IEC 62561-7, and superior conductive material that improves earthing effectiveness especially in areas of poor conductivity such as rocky ground, sandy soil & areas of moisture variation with different soil strata.
- b) The expected composition of the compound is as under.

*Earth enhancement Back Filling Compound Composition with maximum permissible tolerance of ± 10 % in each content.	Conductive Cement:	15 %
	Graphite carbon powder	45%
	Sodium montmorillonite/ Sodium Bentonite Powder	30 %
	Hydrous aluminum silicate	10 %
Maximum permissible limit of Salt content is below 2 %. The Sulphur content in the back-fill compound shall not be more than 2 % in any case. All the component used in the mixture shall be having mesh size at least 200 mesh.		

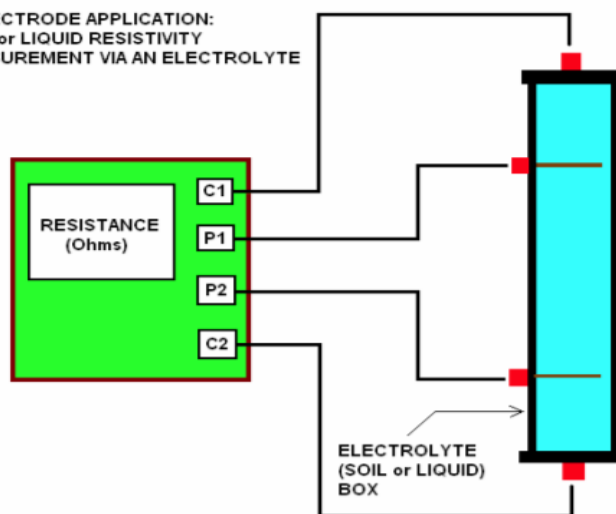
- c) The Earth Enhancement Material/ Backfill compound shall be Highly Conductive Compound, maintenance free. The watering shall be required at the time of its installation

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- only. No re-charging with water, salts or any other chemical shall be required and it shall maintain almost constant earth resistance during its life cycle without manual watering.
- It must set firmly and should not dissolve or decompose or otherwise pollute the soil or the local watertable.
 - It should have capacity to retain more than 10% moisture at 105°C. Test certificate for the same from NABL approved Government/government supported laboratory shall be submitted.
 - Material shall be non-toxic, non-reactive, non-explosive & non-corrosive. It shall not cause burns, irritation to eye, skin etc. It shall not pollute the soil or local water table & shall meet environmental friendly requirements for landfill.
 - It should have better hygroscopic properties to absorb moisture. It should absorb & release the moisture in the dry weather condition and help in maintaining the moisture around the earth electrode. Material shall be thermally stable between temperature ranges of -10°C to 60°C. Material shall not decompose or leach out with time.
 - Material shall not decompose or leach out with time. The leach test shall be tested as per IEC 62561-7 Clause 5.3 at NABL accredited Government/ government supported laboratory.
 - Sulphur Determination test and Corrosion Test - As per IEC 62561-7 clause 5.3 & 5.5 respectively.
 - It is preferable that the resistivity of the backfill compound shall not be higher than 0.20 Ω-cm, when it is tested with 4 electrode method using a soil box having cross section area of 4 cm x 3.2 cm = 12.8 Cm² and keeping the electrodes at a distance of 12.8 Cm. in a soil box. The supplier shall produce the facility of soil box for testing.

4-ELECTRODE APPLICATION:
SOIL or LIQUID RESISTIVITY
MEASUREMENT VIA AN ELECTROLYTE
BOX



(Soil Box testing method)

(Sample Soil Box)

- It should expand & swell considerably & remove entrapped air to create strong connection and bond between earth electrode & soil.
- It should diffuse in to the soil pores & create conductive roots enlarging conductive zone of the earth pit.
- It should be an alkaline in nature with pH value of >7 & <9. Test certificate from NABL approved Government/government supported laboratory to be provided for the compound so designed.



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5.0 PROCEDURE OF INSTALLING EARTH ELECTRODE:

- a) Two different size electrodes are proposed, i.e. 2000 mm and 3000 mm length electrode. Generally, electrode having 3000 mm length is preferable. But, wherever digging of 3000 mm pit is not possible, two parallel earthing of electrodes having 2000mm length are to be used. The earth pits should be dug with the help of an auger (not more than 10" dia.) as per the length of electrode. The manual excavation of pit shall not be entertained. The ready to use electrode is inserted in the pit vertically and then the pit is filled with local soil and water.
- b) At the time of installation, tight filling of mother soil with sufficient watering is required to make contacts of soil uniformly surrounding to the electrode to provide low resistive path to dissipate the fault current in all direction from circular surface of the electrode. The loose earth filling surrounding the new installed earthing may not give low resistance of earthing.
- c) Resistance of the earth pit should be measured before connecting the earth electrode to the network and record of the same shall be preserved. Due care should be taken, as not to measure the earth electrode in live connected condition, the results derived so may be mis-leading.
- d) The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors by way of using Nut-bolts and rigid PVC pipe shall be given as per the specification of DISCOMs.
- e) To validate the quality of capsule, necessary tests/inspection (Proto inspection, lot inspection, Resistance/ Resistivity, Material validation testing, etc.) shall be carried out on the ready capsule, If required by Engineer In charge.
- f) Earthing Display board made up of FRP material having size of 200 mm x 150 mm x 3 mm with following details. It should free standing with suitable mounting stand.
 - (1) Name of Manufacturer/ Trade Name / Supplier
 - (2) PO NO:
 - (3) Feeder Name
 - (4) Earth Pit No
 - (5) Drawing No _____
 - (6) Length Of Electrode in mm
 - (7) Date of Installation
 - (8) Resistance value in Ohm on Installation date
 - (9) Soil Resistivity in Ohm-Meter

6.0 INSPECTION:

- a. The purchaser or his authorized inspector shall have all rights for free access to the manufacturer's works. The manufacturer or his authorized representative shall remain present at all reasonable times and conduct all tests and measurements as per the technical specifications in presence of the purchaser representative shall give facilities to inspect the manufacturing process at any stage of manufacture. The purchaser shall have the right to reject whole or part of any work or material that does not conform to the requirements of the specifications. All the reasonable/complete facilities considered necessary for the inspection by the inspector/s inspecting shall be provided by the manufacturer free of cost.

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- b. All the base material (before mixture) as stated in the Clause no.5 shall be inspected before preparing the sound mixture & sample of the same may be collected by the inspection team while inspection for further assessment.

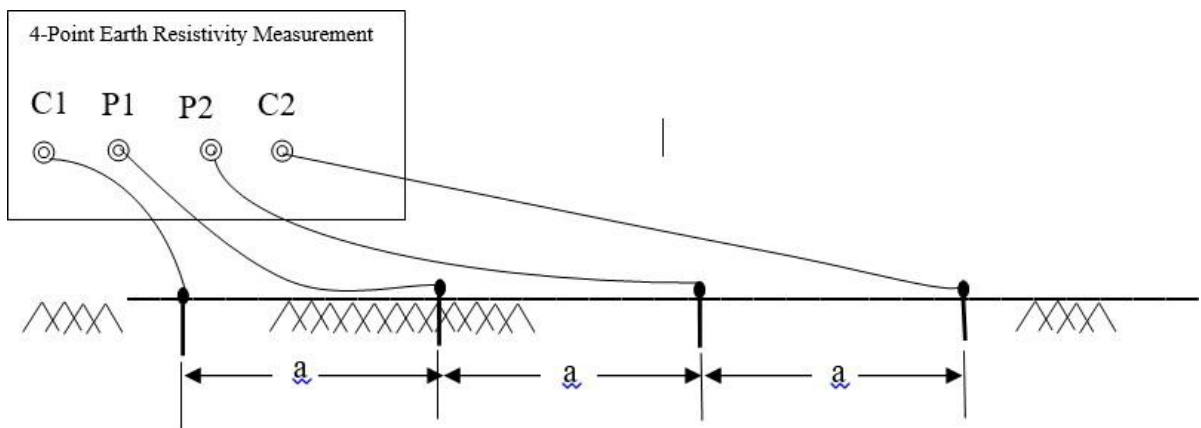
7.0 TESTS CERTIFICATES:

The bidder is required to submit the test certificates as mentioned below, with the bid. All these test certificates shall be carried out at any NABL accredited Government/ Government supported laboratory. These tests should not be older than 5(five) years as on scheduled date of opening of the Technical bid.

- The GI pipe used for the electrode shall be confirming to the relevant standard.
- Toxic Content test on Conductive materials & earth enhancement material as per standard or Leach ability Test
- Short Circuit Withstand Test on Earth electrodes: It should be capable of withstanding short time current of 20 KA (rms) for 1 second.
- All Physical dimensions check of the electrode.
- PH Value Test
- Measurement of zinc Coating of the Earth Electrode
- Sulphur determination Test
- Granular Size of Material

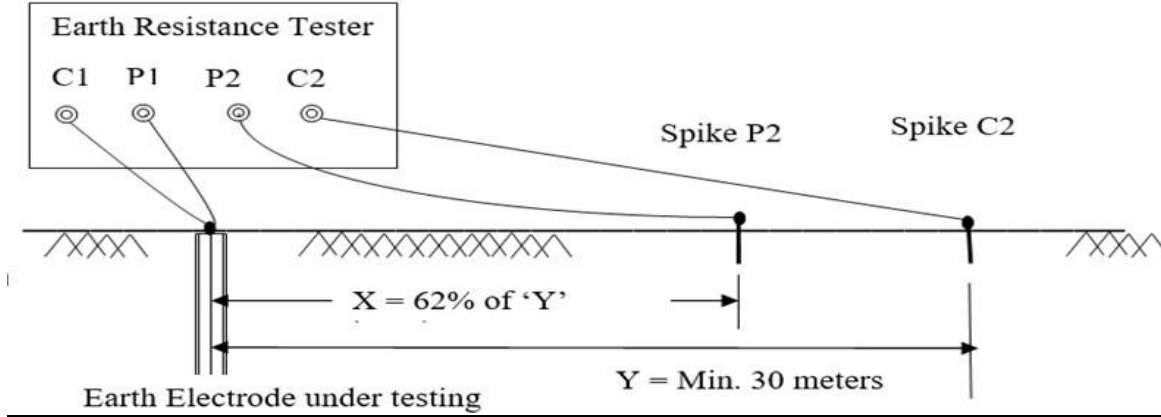
8.0 PROCEDURE OF MEASUREMENT/TESTING:-

- a. MEASUREMENT OF EARTH RESISTIVITY :



b. MEASUREMENT OF EARTHING RESISTANCE:

THE VALUE OF EARTHING RESISTANCE SHOULD BE MEASURE BY FOLLOWING METHOD OF MEASUREMENT.



The connecting wire length of the terminal connecting earth electrode with C1-P1 of megger should not be more than 1 meter. All three electrodes should be in linear alignment to avoid unnecessary addition of extra earth resistance during measurement process.

9.0 GUARANTEE:

The product shall be guaranteed to sustain its initial value of system resistance without its maintenance with tolerance of + 10% for a period of at least 5 years from date of commissioning. The value to be taken as a base value for maintenance free operation should be measured after period of at least one month from the date of commissioning. However, it is desired to have trouble free operation for a period of 15 years. Any defect discovered during the guarantee period have to be rectified free of charge



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GUARANTEED TECHNICAL PARTICULARS

Sr. No.	Technical Particulars	Confirmation (Yes)
1	<p>Electrode: Confirming to IS: 1161-2014.</p> <p><u>For 2000 mm Electrode</u> Length (L): 1900 mm(pipe)+100mm(terminal)=2000 (Min) Outer Diameter (Ø):48 mm (hollow) Thickness (t): 3.2 mm(Min) Weight of electrode : 7.1 (Kg.) At least Cross section Area : 4.53 cm²</p> <p><u>For 3000 mm Electrode</u> Length (L): 2900 mm(pipe)+100mm(terminal)=3000 (Min) Outer Diameter (Ø):48 mm (hollow) Thickness (t): 3.2 mm(Min) Weight of electrode : 10.6 (Kg.) At least Cross section Area : 4.53 cm² (all tolerance will be applicable as per IS:1161-2014)</p>	
2	<p>Galvanized Perforated cage for Earthing :- Dimensions :- 1890 mm X 150 mm for 2000 mm Electrode 2890 mm X 150 mm for 3000 mm Electrode Circular Hole Size of Net: 3.5 mm Dia. Or lesser Thickness of Net : 1.5 mm (min.) with hot dip galvanized Design Versatility :- The cage should be designed with high durability such that in worst transport condition also, the particles of Earth Enhancement Material should not leach out. Handling :- The cage with all content should be design kept in view handling condition at site.</p>	
3	<p>Electrically insulated Enameled Paint Coating : Uniform Paint coating on 150 mm long electrode after terminals The enameled paint coating should have minimum Dielectric strength-20 Kv/mm and min. 4 coat should be applied to the surface of electrode. Optionally, PVC cap of appropriate die- electric strength can be provided to prevent the flow of current in the upper portion.</p>	



4	<p>Zinc coating on electrode :- The entire primary electrode & cage shall be hot dip galvanized with at least 150 microns over all surfaces without leaving any point of the electrode un-galvanized and cage shall be hot dip galvanized with at least 80 microns in accordance with IS 4736: 1986 in accordance with IS 4736: 1986. The process of hot-dip galvanizing shall be followed as per IS: 2629. For uniform distribution of fault currents, an earth electrode must be</p>									
5	<p>cylindrical in shape.</p> <p>Mixture proportion for Earth enhancement Back Filling Compound Confirming to IEC: 62561-7</p> <table border="0"> <tr> <td>Conductive Cement:</td> <td>15 %</td> </tr> <tr> <td>Graphitecarbonpowder</td> <td>45%</td> </tr> <tr> <td>Sodiummontmorillonite/ Sodium Bentonite Powder</td> <td>30 %</td> </tr> <tr> <td>Hydrous aluminum silicate</td> <td>10 %</td> </tr> </table> <p>Sulphur content < 2 % Content tolerance of ± 10 % Resistivity < 0.2 Ω-m Saltscontents<2% All the component used in the mixture shall be having mesh size between 150-200 mesh.</p>	Conductive Cement:	15 %	Graphitecarbonpowder	45%	Sodiummontmorillonite/ Sodium Bentonite Powder	30 %	Hydrous aluminum silicate	10 %	
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6	<p>Earth pit:- Method of digging Earth Pit:-through Bore/auger machine Diameter =200 mm</p>									
7	<p>Confirmation of cope of work, Supply, Installation, commissioning and testing procedure as mentioned in specification</p>									